

# Characterization of GLDC Mega-environments

This report is commissioned by ICRISAT to accompany the proposal on  
CGIAR Research Program on  
Grain Legumes and Dryland Cereals Agri-food Systems

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## Characterization of GLDC Mega-environments

South Asia (SA) and sub-Saharan Africa (SSA) are characterized by two major agroecologies of interest to the Grain Legume and Dryland Cereal (GLDC) CRP proposal: the semi-arid and sub-humid drylands. SSA can be further subdivided into West Africa (WA), East Africa (EA) and Southern Africa (SA). Even though the SSA regions may not have common dependencies or cultural heritage (Figure 1), they do come together to form developmental cooperation organizations such as the African Union and Economic Community of West African States (ECOWAS)<sup>1</sup> to tackle common issues and resourcing. In the context of GLDC, the two continents and their subregions share similarities in terms of climate, agroecologies and pressing 'grand challenges'<sup>2</sup>. All the dryland GLDC crops are grown on these two continents and, consequently, characterization of mega-environments can be based on the critical commonalities which makes these regions a focus for sustainable development. This write-up focuses on the relevant regions covering the semi-arid and sub-humid agroecologies of SSA and SA.

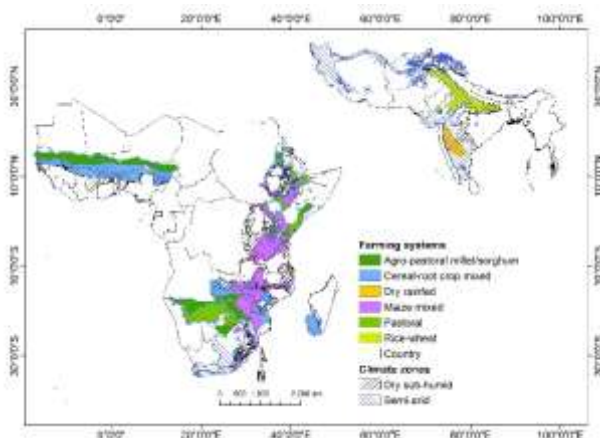


Figure 1. The mega-environments for GLDC crops.

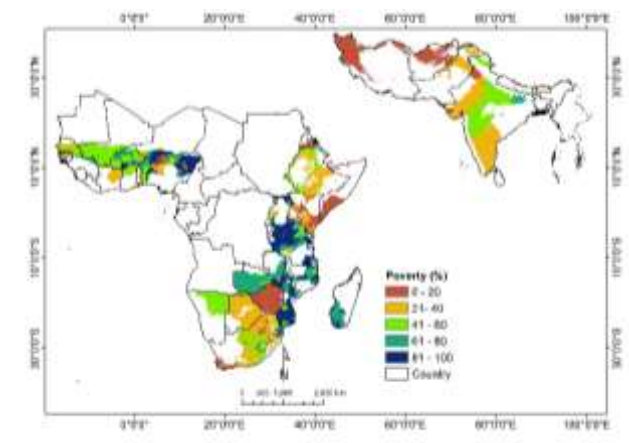


Figure 2. Poverty percentage in the mega-environments.

### West Africa

The West African region consists of 18 countries (Benin, Burkina Faso, Cape Verde, Gambia, Ghana, Guinea, Guinea-Bissau, Cote d'Ivoire, Liberia, Mali, Mauritania, Niger, Nigeria, St Helena, Senegal, Sierra Leone, São Tomé and Príncipe and Togo) spanning 5.11 million sq km and a total population of 349 million. Of this geographical area, 1.02 million sq km cover the semi-arid agroecology and 0.73 million sq km the sub-humid agroecology, i.e., 1/3 of the region has a highly variable climate and erratic rainfall. The number of poor (at US\$2.00 PPP) stand at around 34 million and 66 million in the sub-humid and semi-arid dryland agroecologies, respectively (Figure 2). An average 20% of children below the age of 5 are severely stunted in the sub-humid ecoregion and around 23% being the corresponding figure for the semi-arid ecoregion (Figure 3).

West Africa has shallow and poor soils. Except for areas along the River Nile that are irrigated by surface water, there rest are rainfed, with GLDC crops grown on 84,416 sq km in the sub-humid ecoregion and on 229,555 sq km in the semi-arid ecoregion. The Length of Growing Period (LGP) in the semi-arid ecoregion varies from 90-179 days and in the sub-humid ecoregion from 180-269 days. Since rainfall in West Africa usually occurs in a few spurts of very intense rainy days, it is necessary to conserve water to sustain crops. In such instances, short-duration varieties can reduce the yield gap. Diversification of the cereal systems by including legumes is also a profitable proposition.

<sup>1</sup> ECOWAS (2017). Economic Community of West African States. <https://au.int/en/recs/ecowas>. (accessed 30 July 2017).

<sup>2</sup> CGIAR SRF 2016-2030 <http://www.cgiar.org/our-strategy/>

## East Africa

East Africa is grouped into 9 countries (Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Somalia, Tanzania and Uganda) which are geographically adjacent. The region has a topography that ranges from the hilly region of Ethiopia to the rift valley region in Kenya and the large unexploited regions of Tanzania. The semi-arid ecoregion occupies 2.1 million sq km and has 39 million poor people (at US\$2.00 PPP). The sub-humid ecoregion occupies 1.4 million sq km with a total population of 279 million (2015) and 61 million poor (at US\$2.00 PPP), outnumbering those in the semi-arid ecoregion (Figure 2). Stunting in children below the age of 5 is an important indicator of poverty. In sub-humid East Africa, 20% of the children are severely stunted (Figure 3) and 47% moderately stunted, with corresponding figures of 19% and 44% in semi-arid East Africa (Figure 4).

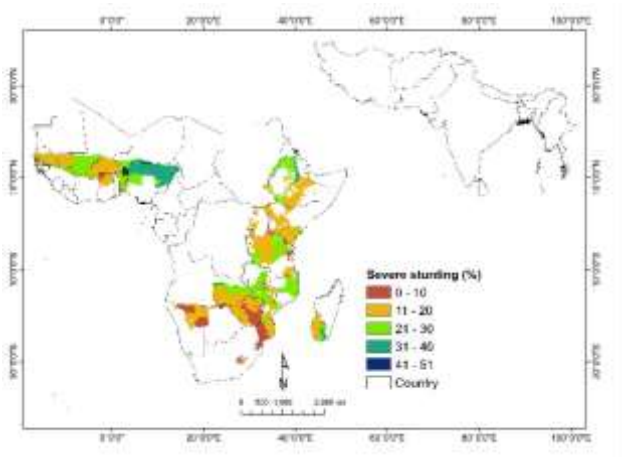


Figure 3. The prevalence of severe stunting in the mega-environments

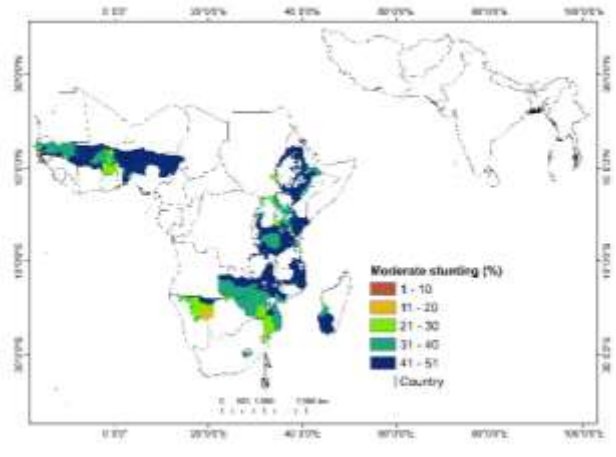


Figure 4. The prevalence of moderate stunting in the mega-environments.

Low fertility and traditional ways of crop management can be a few causes of low productivity. Precipitation in East Africa is characterized by a dry annual mean climatology compared to other deep tropical land areas and a bimodal annual cycle. The major rainy season is during March–May (often called the “long rains”) and the second during October–December (often called the “short rains”). The region’s complex topography is mainly responsible for this climate. While the region lies in the deep tropics and is surrounded by the world’s major monsoons (the South Asian monsoon, the West African monsoon, and the Australian monsoon), it exhibits neither a wet climate in terms of annual mean precipitation nor a monsoonal climate in terms of annual cycle of precipitation. Instead, it is dominated by a semi-arid/arid climate with a bimodal annual cycle of precipitation. The LGP ranges from 120-149 days in the semi-arid ecoregion and from 180-209 days in the sub-humid ecoregion. The agricultural sector is dominated by smallholder mixed farming of livestock, food crops, cash crops, fishing and aquaculture. GLDC crops are grown on 28,879 sq. km in the sub-humid ecoregion in East Africa and on 31,113 sq km in the semi-arid ecoregion.

The livestock subsector consists of cattle, sheep, goats, and camels, reared mainly for meat and milk production; pigs and poultry for white meat and eggs respectively; and hide and skin for export and industrial processing. Fishery products include both freshwater fish from rivers, dams and lakes and marine fish from the Indian Ocean. Forestry products include fruits, honey, herbal medicine, timber and wood for fuel.

## Southern Africa

The southern African countries are Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe. The semi-arid ecoregion in Southern Africa covers 1.4 million sq km whereas the sub-humid ecoregion covers only 0.16 million sq km. The GLDC crops are grown on 13,362 sq km in the sub-humid ecoregion and on 12,619 sq km in the semi-arid ecoregion. The average LGP in this region is 60-89 days and the average annual rainfall is 479 mm. There is a clear division of crop distribution in this region. Zambia and Zimbabwe grow GLDC cereals and Malawi and Mozambique grow legumes (chickpea, pigeonpea and groundnut) in the sub-humid ecoregion. In the semi-arid ecoregion, Malawi, Mozambique and Namibia grow all the GLDC crops, the reason being the short growing season and the varieties that are adapted to the agroecology. Other countries in the region have negligible area with potential for GLDC crops.

There are 4.2 million poor in the sub-humid ecoregion (at US\$ 2.00 PPP) compared to 8.3 million in the semi-arid ecoregion (Figure 2). Coming to trends in stunting in children, 16% of children are severely stunted in the sub-humid ecoregion and 37% moderately stunted, while 13% are severely stunted and 33% moderately stunted in the semi-arid ecoregion (Figure 3).

## South Asia

This part of Asia has the highest pressure on land for production. The grain yield of staples has stagnated due to the growing needs of the population. The semi-arid ecoregion spans 1.8 million sq km in this part of the world and the sub-humid ecoregion 0.7 million sq km, supporting many rainfed cropping systems. The GLDC crops are grown over 0.5 million sq km in the sub-humid ecoregion and on 0.3 million sq km in the semi-arid ecoregion. The low coverage in the semi-arid ecoregion is due to the decreasing area under sorghum and pearl millet in the Indian subcontinent over the last 30 years. The average LGP ranges between 90-119 days and average annual rainfall is 516 mm in the semi-arid ecoregion. The average LGP ranges between 150-180 days and average annual rainfall is 919 mm in the sub-humid region.

In South Asia, there are 265 million poor (at US\$2.00 PPP) in the sub-humid drylands and 280 million in the semi-arid drylands (Figure 2). The number of underweight children under 5 number 15.4 million in the sub-humid ecoregion and 33.5 million in the semi-arid ecoregion. Characterization of these regions with relevant variables helps in understanding the present situation and underlines the prioritization required in terms of improving the livelihood of smallholder farmers based on evolving markets and demand-driven innovations (Table 1).

**Table 1: Poverty head count in mega-environments.**

Zone: Region	Poor head count (US\$1.25)	Poor head count (US\$1.25) %	Poor head count (US\$2.00)	Poor head count (US\$2.00) %	Severely stunted children (<5 years)	Moderately stunted children (<5 years)
Dry sub-humid: East Africa	47,580,322	70	61,297,043	83	2,587,932	6,200,199
Dry sub-humid: Southern Africa	4,158,061	35	6,666,676	57	21,416	60,077
Dry sub-humid: South Asia	145,402,638	42	264,608,160	77	- NA -	- NA -
Dry sub-humid: West Africa	21,534,446	52	34,200,021	79	1,636,826	2,782,666
Semi-arid: East Africa	27,136,080	43	38,884,358	63	1,684,244	4,015,227
Semi-arid: Southern Africa	8,268,120	37	13,234,812	56	26,048	77,597
Semi-arid: South Asia	148,701,475	22	280,042,220	49	- NA -	- NA -
Semi-arid: West Africa	49,726,755	60	65,537,630	78	4,456,875	7,556,670